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The Influence of Preparation and Handling on the Safety of Food Service Items

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UNIVERSITY HONORS PROGRAM

SENIOR PROJECT - APPROVAL

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PROJECT TITLE: The Influence of Preparation and Handling on the Safety of Food Service Items

I have reviewed this completed senior honors thesis with this student and certify that it is a project commensurate with honors level undergraduate research in this field.

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Comments (Optional):

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Introduction:

In the United States, it is estimated that there are 76 million cases of foodborne illness annually along with 324,000 hospitalizations and 5,200 deaths (Mead et al., 1999). In addition, recent foodborne illness statistics from the Centers for Disease Control and Prevention show that approximately 53% of all known source outbreaks occur as a result of consumption of contaminated food from food service establishments (CDC, 2000). The main contributing factor for these foodborne disease outbreaks in food service establishments is thought to be improper food holding temperatures.

In order to illustrate the importance of proper food temperatures on health and safety, the purpose of this project was to conduct research correlating microbial growth to food cooking temperatures. A primary objective was to establish a scientific basis for the U.S. Food and Drug Administration *Food Code*, which provides recommendations for the proper handling of food items. In addition, this research will be used to provide supporting information and illustrations for the development of a food safety education program for food service personnel and high risk individuals in schools, child care facilities, nursing homes, and hospitals, as well as those involved in programs for pregnant women such as the USDA Women, Infants, and Children Program (WIC). In the future, this course will be a coordinated effort involving the University of Tennessee and the University of Florida Food Science Departments and the Tennessee Food Safety Center of Excellence.

Research conducted to achieve the goals of this project included performing a survey of foods from local cafeterias. The results of this study provided information on the microbial content of foods handled according to the U.S. Food Code. The study was then continued at a local food service agency. At the establishment, a specific product, tortilla soup, was selected for further experimentation due to its wide spread popularity among customers. Samples of tortilla soup were collected from the food service agency and plated to determine the amount of microorganisms able to survive the cafeteria's heating process. Preparation of the soup was repeated in the lab at much lower temperatures to determine if lower temperatures would continue to kill microorganisms present in the sample.

Experimental Procedure:

To begin this project, a survey was conducted on food samples collected from local cafeterias. The purpose of this survey was to gather background information on the microbial content of foods prepared using the U.S. Food Code. Three foods were selected for this survey, including hamburger, pasta, and beef stew. These items were chosen because they represented solid, semi-solid, and liquid foods, respectively. A portion of each product was collected in a sterile bag and taken to the laboratory. In the lab, 10^{-2} to 10^{-5} dilutions were performed on the samples. The dilutions were then plated on Standard Methods Agar and incubated for 48 hours at 32°C. After incubation, the number of isolated colonies were counted and recorded. This data is shown in Table 1.

The next phase of this project involved selecting a specific food product prepared and served at a food service establishment. The product chosen was tortilla soup, a salsa-like soup that was poured over tortilla chips and topped with cheese. The first step in

working with this product was to observe the method used by the food handlers to prepare this soup. In order to make the soup, 12 onions were sautéed in 16oz. margarine. Next, two 6lbs., 6oz. cans of chopped tomatoes and one can of tomato sauce were added. Chicken stock, chopped green chilies, 2 Tbsp. Cayenne pepper, 4 Tbsp. Garlic, and 5 Tbsp. Cumen were also stirred into the mixture. The soup was simmered for 40 minutes at 250°F. While the soup was simmering, chicken breasts were steamed for 35 minutes to 190°F and cooled in a blast freezer to 40°F. Then the chicken was diced and added to the soup. The soup was again allowed to simmer for one hour, after which it was served over tortilla chips and topped with cheddar cheese. During this process, samples were collected at various stages, placed in sterile sample bags, and taken to the lab to plate. Immediately before each sample was collected, the temperature of the soup was determined and recorded. Once in the lab, 10^{-2} to 10^{-5} dilutions were performed with the samples. The standard methods agar plates of tortilla soup were likewise incubated for 48 hours at 32°C. After the incubation period, the aerobic plate counts were obtained and can be seen in Table 2.

Next, laboratory simulations of the process used by the food service agency to prepare tortilla soup were performed. However, in these simulations, the primary focus was on the chicken used in the soup. Two chicken breasts obtained from the establishment were cut into smaller, approximately equal pieces. These pieces were then steamed for 10, 15, and 20 minutes. After each piece of chicken was steamed, the temperature of the center of the chicken was obtained and recorded. 10^{-2}-10^{-5} dilutions were performed on the samples and plated on Standard Methods Agar. The plates were

then incubated for 48 hours at 32°C. Aerobic plate counts were determined and recorded in Table 3 and Table 4.

Results:

Table 1: Microbial Content of Three Food Products Collected at Local Cafeterias

Product	Dilution	Aerobic Plate Count
Hamburger	10^{-2}	0
	10^{-3}	0
	10^{-4}	0
	10^{-5}	0
Pasta	10^{-2}	0
	10^{-3}	0
	10^{-4}	0
	10^{-5}	0
Beef Stew	10^{-2}	45
	10^{-3}	2
	10^{-4}	0
	10^{-5}	0

Table 2: Aerobic Plate Counts Obtained from Tortilla Soup

Product	Temperature	Dilution	Aerobic Plate Count
Tortilla Soup Before Adding Chicken	199°F	10^{-2}	0
		10^{-3}	0
		10^{-4}	0
		10^{-5}	0
Tortilla Soup After All Ingredients Added	184°F	10^{-2}	0
		10^{-3}	0
		10^{-4}	0
		10^{-5}	0
Tortilla Soup One Hour After Cooking	200°F	10^{-2}	0
		10^{-3}	0
		10^{-4}	0
		10^{-5}	0
Tortilla Soup One Hour After Serving	166°F	10^{-2}	0
		10^{-3}	0
		10^{-4}	0
		10^{-5}	0

Table 3: Microbial Growth on Samples Collected from Chicken Breast #1

Product	Dimensions	Time	Temperature	Dilution	Aerobic Plate Count
Chicken 1A	Depth: 23mm Length: 84mm	0 min.	Frozen	10^{-2} 10^{-3} 10^{-4} 10^{-5}	205 24 2 2
Chicken 2A	Depth: 20mm Length: 85mm	10 min.	133°F	10^{-2} 10^{-3} 10^{-4} 10^{-5}	0 0 0 0
Chicken 3A	Depth: 19mm Length: 100mm	15 min.	147°F	10^{-2} 10^{-3} 10^{-4} 10^{-5}	0 0 0 0
Chicken 4A	Depth: 18mm Length: 76mm	20 min.	152°F	10^{-2} 10^{-3} 10^{-4} 10^{-5}	0 0 0 0

Table 4: Microbial Growth on Samples Collected from Chicken Breast #2

Product	Dimensions	Time	Temperature	Dilution	Aerobic Plate Count
Chicken 1B	Depth: 27mm Length: 72mm	0 min.	Frozen	10^{-2} 10^{-3} 10^{-4} 10^{-5}	303 80 3 0
Chicken 2B	Depth: 29mm Length: 90mm	10 min.	134°F	10^{-2} 10^{-3} 10^{-4} 10^{-5}	9 0 0 0
Chicken 3B	Depth: 22mm Length: 80mm	15 min.	151°F	10^{-2} 10^{-3} 10^{-4} 10^{-5}	2 0 0 0
Chicken 4B	Depth: 22mm Length: 102mm	20 min.	152°F	10^{-2} 10^{-3} 10^{-4} 10^{-5}	0 0 0 0

Discussion:

The results of the survey conducted on foods from local cafeterias showed the hamburger and the pasta as having no detectable microbial growth following incubation. This means that using the U.S. *Food Code* to prepare foods produced an undetectable level of microorganisms in the food products. The exception was the beef stew, which was apparently contaminated due to an unknown source.

Table 2, on the other hand, showed the heating process used by the Children's Hospital to prepare tortilla soup. As can be seen by the results, the heating process adequately destroyed microorganisms present in the product and no microbes were detected on any of the plates. These results were expected due to the high temperatures used in the preparation of the tortilla soup.

In the next table, Table 3, isolated microbial colonies did appear in the raw, frozen chicken. For the first chicken breast, the level of microorganisms was approximately 2×10^4, which was considered a normal level for raw chicken. However, after being steamed for 10 minutes and cooked to an internal temperature of 133°F, no microbes were detectable on the chicken. Again, at an internal temperature of 147°F and after 15 minutes of steaming, no detectable levels of microorganisms were found. Likewise, no colonies were obtained after 20 minutes of steaming the chicken to an internal temperature of 152°F.

Table 4 showed similar results. The raw chicken started out with 3×10^{-4} microbial level, which was slightly higher than the first chicken breast but still expected for raw chicken. At an internal temperature of 134°F, after 10 minutes in the steamer, microbial destruction was evident. At this temperature, only 9 microorganisms were

detected in the 10^{-2} dilution. At 151°F, after 15 minutes of being steamed, the chicken sample was found to have only 2 colonies present in the 10^{-2} dilution. Then, after 20 minutes in the steamer and after the internal temperature had reached 152°F, no microbes were detected on the chicken.

By comparing the results from Table 3 and Table 4, it was concluded that variation can exist within similar products. The two chicken breasts not only differed in size, with the second chicken being thicker in depth and shorter in length, they also differed in the original microbial content.

The results of the laboratory simulation showed evidence that microbial destruction for the chicken breasts began at least at an internal temperature of 133°F. However, the *U.S. Food Code* requires poultry to be cooked to heat all parts of the food to a temperature of 165°F or above for 15 seconds (Food and Drug Administration 1999). The results of this research showed that temperatures required by the *Food Code* may be unnecessarily high for skinless chicken breasts. Additional research, including an inoculation study, is recommended to validate this conclusion.

References:

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